The SPECIALIST Lexicon and Lexical Tools

June 12, 2012

Allen Browne
Chris Lu
Lexical tools

SPECIALIST LEXICON

Text processing
The SPECIALIST lexicon

- A syntactic lexicon
- Biomedical and general English
- Over 469,000 records
Lexicon Growth

Graph showing the growth of lexical items and inflected forms over the years 1994 to 2012.
Frequency Spectrum of Medline 2006

V(m,N) vs. M
Frequency Spectrum: Alice in Wonderland

Bayaan, 2001
The Long Tail

Number of Words ->

Word Frequency ->
The SPECIALIST LEXICON

- Morphology
  - Inflection
  - Derivation
- Orthography
  - Spelling variants
- Syntax
  - Complementation for verbs, nouns, and adjectives
Morphology

- **Inflectional**
  - nucleus, nuclei
  - cauterize, cauterizes, cauterized, cauterizing
  - red, redder reddest

- **Derivational**
  - laryngeal -- larynx
  - transport -- transportation
I suppose you could say I’m a dictionaryologist.

Dictionary+ology+ist
Orthography

Spelling Variation

- align -- aline
- Grave’s disease -- Graves’s disease -- Graves’ disease
- anesthetize -- anesthetise
- Esophagus -- oesophagus
- foetus -- fetus
- centre -- center
Syntax -- Verb Complements

- **intran**
  - I’ll treat.

- **tran=np**
  - He treated the patient.

- **ditran=np,pphr(with,np)**
  - She treated the patient with the drug.
Syntax -- Verb Complements

{base=treat
 entry=E0061964
   cat=verb
   variants=reg
   intran
   tran=np
   tran=pphr(with,np)
   tran=pphr(of,np)
   ditran=np,pphr(to,np)
   ditran=np,pphr(with,np)
   ditran=np,pphr(for,np)
   cplxtran=np,advbl
   nominalization=treatment|noun|E0061968
}
Syntax -- Verb Particle Constructions

- clean up
- scrub down
- look up
{base=clean
  entry=E0017272
cat=verb
variants=reg
intran
intran;part(up)
tran=np
tran=np;part(up)
nominalization=clean|noun|E0017273
nominalization=cleanup|noun|E0319808}
Categories – Parts of Speech
Lexicon Unit Records

{base=Kaposi's sarcoma
 spelling_variant=Kaposi sarcoma
 entry=E0003576
  cat=noun
  variants=uncount
  variants=reg
  variants=glreg
}

{base=chronic
 entry=E0016869
  cat=adj
  variants=inv
  position=attrib(1)
  position=pred
  stative
}

{base=aspirate
 entry=E0010803
  cat=verb
  variants=reg
  tran=np
  nominalization=aspiration|noun|E0010804
}

{base=in
 entry=E0033870
  cat=prep
}

Orthographic vs. Lexicographic Word:

Why, for instance, if a two-word boy scout feels chilly on his one-word campground, does he pull up a two-word camp chair in front of his one-word campfire? Anyone who seeks a strictly logical answer to such questions is chasing will-o'-the-wisps (chargeable in telegrams as a single word, because of the hyphens) in a semantic bog.

{base=resume
spelling_variant=résumé
spelling_variant=resumé
entry=E0053099
  cat=noun
  variants=reg
}

{base=role
spelling_variant=rôle
entry=E0053757
  cat=noun
  variants=reg
}

{base=deja vu
spelling_variant=deja-vu
spelling_variant=déjà vu
entry=E0021340
  cat=noun
  variants=uncount
}

{base=cafe
spelling_variant=café
entry=E0420690
  cat=noun
  variants=reg
}
Noun Variants

{base=Kaposi's sarcoma
 spelling_variant=Kaposi sarcoma
 entry=E0003576
   cat=noun
   variants=uncount
   variants=reg
   variants=glreg
 }

- Kaposi’s sarcoma
- Kaposi’s sarcomas
- Kaposi’s sarcomata
- Kaposi sarcoma
- Kaposi sarcomas
- Kaposi sarcomata
Regular Nouns

The plural suffix is *s*. 

*y* becomes *ie* following a consonant before *s*. 
*e* is inserted before *s* if the base ends in *s*, *z*, *x*, *ch*, or *s*

Leach – Leaches
Stomach – Stomachs ➔ irregular
# Greco-latin Regular Nouns

<table>
<thead>
<tr>
<th>Singular ends with:</th>
<th>Plural ends with:</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>-us</td>
<td>-i</td>
<td>focus/foci</td>
</tr>
<tr>
<td>-ma</td>
<td>-mata</td>
<td>trauma/traumata</td>
</tr>
<tr>
<td>-a</td>
<td>-ae</td>
<td>larva/larvae</td>
</tr>
<tr>
<td>-um</td>
<td>-a</td>
<td>ilium/ilia</td>
</tr>
<tr>
<td>-on</td>
<td>-a</td>
<td>taxon/taxa</td>
</tr>
<tr>
<td>-sis</td>
<td>-ses</td>
<td>analysis/analyses</td>
</tr>
<tr>
<td>-is</td>
<td>-ides</td>
<td>cystis/cystides</td>
</tr>
<tr>
<td>-men</td>
<td>-mina</td>
<td>foramen/foramina</td>
</tr>
<tr>
<td>-ex</td>
<td>-ices</td>
<td>index/indices</td>
</tr>
<tr>
<td>-x</td>
<td>-ces</td>
<td>matrix/matrices</td>
</tr>
</tbody>
</table>
Uncount Nouns
(abstract or mass)

{base=smallpox
 entry=E0056359
  cat=noun
  variants=uncount
}
{base=potassium
 entry=E0049387
  cat=noun
  variants=uncount
}

* a smallpox
* two smallpoxes
much smallpox
* a potassium
* two potassiuims
much potassium

* This form does not occur
Countability

- Mail
  * A mail
  much mail
  * many mails

- E-Mail
  An e-mail
  much e-mail
  many e-mails

* This form does not occur
Fixed Plural Nouns

{base=police
entry=E0048616
cat=noun
variants=plur
}

{base=scissors
entry=E0054633
cat=noun
variants=plur
}
Irregular Nouns

{base=corpus
 entry=E0019113
   cat=noun
   variants=irreg|corpora|
   variants=reg
 }

{base=larynx
 entry=E0036919
   cat=noun
   variants=irreg|larynges|
   variants=reg
 }
Regular Verbs

- The third person present tense suffix is **s**.
  - *y* becomes *ie* following a consonant before *s*.
  - *e* is inserted between *z*, *x*, *ch*, or *sh* and *s*.

- The past tense suffix is **ed**.
  - *y* becomes *ie* following a consonant before *ed*.
  - Final *e* is deleted before *ed*.

- The past participle is the same as the past tense.
- The present participle suffix is **ing**.
  - *y* becomes *ie* following a consonant before *ing*.
  - Final *e* is deleted before *ing* unless preceded by *e*, *y* or *o*. 
Regular Verbs

- dismiss: dismisses, dismissed, dismissing
- agree: agrees; agreed; agreeing
- dry: dries, dried, drying
Regular Doubling Verbs

- End in a CVC pattern
- Double the final consonant before *ed* and *ing*.
- Are otherwise regular
- variants=regd

control: controls, controlled, controlling
Irregular Verbs

**Bite:** bite, bites, bit, bitten
Irregular Verbs

{base=bite
 entry=E0013219
 cat=verb
 variants=irreg|bite|bites|bit|bitten|biting|
 intran
 tran=np
 cplxtran=np,advbl
}
Ancillary Data Bases

- **Synonymy**
  - sm.db

- **Derivation**
  - dm.db, dm.rules

- **Inflection**
  - im.rules

- **Neoclassical compounds**
  - nc.db
Derivational Facts and Rules

dm.facts

treatment|noun|treat|verb
prohibition|noun|prohibitive|adj
cell lineage|noun|cell line|noun
photochemotherapeutic|adj|photochemotherapy|noun
pharmacotherapeutic|adj|pharmacotherapy|noun
Derivational Facts and Rules

dm.rules

# e.g. alienation|alienate
  ation$|noun|ate|verb
  ration|rate; station|state;
# Noun rules (glreg)

<table>
<thead>
<tr>
<th>Singular</th>
<th>Plural</th>
</tr>
</thead>
<tbody>
<tr>
<td>antus</td>
<td>anti;</td>
</tr>
<tr>
<td>mata$</td>
<td>noun</td>
</tr>
<tr>
<td>a$</td>
<td>noun</td>
</tr>
<tr>
<td>um$</td>
<td>noun</td>
</tr>
<tr>
<td>on$</td>
<td>noun</td>
</tr>
<tr>
<td>sis$</td>
<td>noun</td>
</tr>
<tr>
<td>is$</td>
<td>noun</td>
</tr>
<tr>
<td>men$</td>
<td>noun</td>
</tr>
<tr>
<td>ex$</td>
<td>noun</td>
</tr>
<tr>
<td>x$</td>
<td>noun</td>
</tr>
</tbody>
</table>
Neoclassical compounds

nc.db

abdomin(o)|abdomen|root
ab|away from|prefix
acanth(o)|prickle|root
acar(o)|mite|root
acetabul(o)|acetabulum|root
ad|towards|prefix
agogue|inducing|terminal
albumin(o)|albumin|root
sis|condition|terminal
stomy|surgical opening|terminal
pneu.mo.no.ul.tra.mic.ro.scop.ics ilico.vol.ca.no.co.ni.o.sis

\'n(y)u:-m*-(.)no--.*l-tr*-.mi--kr*-'ska:p-ik-'sil-i-(.)ko--(.v\n
[NL, fr. Gk pneumo-n + ISV ultramicroscopic + NL silicon +]a:l-'ka--no--.ko--ne--'o--s*s ISV volcano + Gk konis dust : a pneumoconiosis caused by the inhalation of very fine silicate or quartz dust

The Protein of a tobacco mosaic virus, Dahlemense strain

acetylseryltyrosylserylisoleucylthreonylserylserylprolylserylglutaminylphenylalanylvalylphenylalanylleucylserylserylserylserylvalyltryptophylalanylasparaginylprolylserylglutaminylthreonylglutaminylglutaminylglutaminylalanylarginyllthreonylthreonylglutaminylvalylglutaminylglutaminylglutaminylphe
nylalanylserylglutaminylvalyltryptophylllysylprolylphenylalanylprolylglutaminylserylthreonylvalylarginyllphenylalanlylserine
Synonyms

**sm.db**

alar | adj | wing | noun
amygdaline | adj | tonsil | noun
articular | adj | joint | noun
bulbar | adj | medulla oblongata | noun
funduncular | adj | boil | noun
genicular | adj | knee | noun
hepatocellular | adj | liver cells | noun
lazar | adj | leprosy | noun
lenticular | adj | crystalline lens | noun
ypsiform | adj | upsiloid | adj
wolfram | noun | tungsten | noun
double vision | noun | diplopia | noun
Lexical Tools

- **Wordind** -- breaks strings into words
  - Produces the Metathesaurus word indexes (MRXW)
- **LVG** -- performs various lexical transformations
- **NORM** -- a selection of LVG transformations,
  - Used for Metathesaurus indexing
  - Produces the Metathesaurus Normalized word and string indexes (MRXNW & MRXNS)
  - Used to access those indexes
Normalization

- Hodgkin Disease
- HODGKINS DISEASE
- Hodgkin's Disease
- Disease, Hodgkin's
- HODGKIN'S DISEASE
- Hodgkin's disease
- Hodgkins Disease
- Hodgkin's disease NOS
- Hodgkin's disease, NOS
- Disease, Hodgkins
- Diseases, Hodgkins
- Hodgkins Diseases
- Hodgkins disease
- hodgkin's disease
- Disease;Hodgkins
- Disease, Hodgkin
- disease hodgkin
The Lexical Systems Group

- Allen Browne: browne@nlm.nih.gov
- Chris Lu: lu@nlm.nih.gov